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The canvas should overlap the ring by about an inch all round. An ordinary boiler, such as is found on every farm, is filled with water and heated to the boiling point.

Two vessels of sufficient size are placed near it. These may be designated 1 and 2. Supposing the boiler to contain 35 gallons of boiling water, if 12½ gallons of cold and the same quantity of boiling water be put into each vessel, we shall have 25 gallons of water at 132° F., in both of them. The exact temperature may be readily obtained by adding a little more hot or cold water, as the thermometer shows to be required.

A basket containing three-quarters of a bushel of grain, which must not be more than 8 inches in depth, is now dipped into No. 1 four times; this will take rather more than half a minute, and will reduce the temperature of the water 8 or 9 degrees. It is now to be rapidly dipped five or six times into No. 2, which will take about one minute, and then dip once per minute for three minutes longer, *i. e.*, five minutes altogether in the two vessels This will reduce the temperature of the water in No. 2 from 132° to 129° to 130°. If steeped barley be used the original temperature of the vessels should be 129° to 130°; but with unsteeped grain, for oats, wheat or rye, it does not matter if the original temperature be 133° to 136°.

The seed must now be cooled. This is best done by placing the basket on the top of a third vessel and pouring a couple of buckets of cold water upon the grain in it, taking care that the cold water falls not only upon the center, but round the edges, so that the corn may be uniformly cooled. The basket is now emptied on the floor and the seed spread out in a thin layer, so that it may cool completely. The water used in cooling the grain will have its temperature raised and may be employed in replenishing the boiler. The requisite temperature (132° F.) of vessels Nos. 1 and 2 must be maintained throughout the process by adding from time to time boiling water from the boiler and transferring from them a similar amount back again to the boiler. The temperature must be regulated by a thermometer, which when used must be plunged deeply into the water.

The basket must be completely immersed each time, then lifted quite out of the water so as to allow it to drain for four or five seconds before it is dipped again.

The above process in practice will be found simple and easy enough to perform, although its description is necessarily somewhat complicated.

REVIEWS OF RECENT LITERATURE.

ARTHUR, J. C. *Smut of Wheat and Oats.* Bulletin of the Agricultural Experiment Station of Indiana, No. 28, September, 1889.

While containing little or nothing new, this little bulletin is full of practical matter and will be an invaluable aid to those whose crops are attacked by these diseases.

Most of the bulletin is taken up with *Tilletia fœtens*, or "stinking smut," as Professor Arthur calls it, to distinguish it from black smut.

The fungus is described, and some space is devoted to early opinions as to the origin of smut. In the discussion of the name the author says that the name *Tilletia lævis* should be changed to *T. fœtens*, Rav., since Ravenel was the first to describe and name it.

Under the heading "attack and spread of the disease" the following questions are proposed and answered: "Will the smut spread from field to field while the crop is growing, as rust does? Will there be any danger of introducing it on one's farm by sowing seed wheat from a farm known to be smutted? Can the disease be introduced by the ap-

plication of manure from a farm where it has already gained a foot-hold? When it once gets into the soil will it persist as milk-weed, quack-grass, and Canada thistle do?"

The answer to the first question depends upon when and where the germinating spore enters the wheat plant. It has been pretty well settled that the plant is infected at the time of germination, and the germ tube enters near where the plantlet is attached to the grain. The practical application of this fact is that grains covered with soil can only receive infection from spores that were sown with the seed or already existed in the soil, but that smut will not spread during the growing season from field to field or from plant to plant.

The answer to the second question is a logical sequence of the preceding. If a crop has any portion smutted it is more than probable that the spores of smut will get in contact with the sound wheat kernels. One crushed kernel thoroughly distributed through a bin of seed wheat may result in many dollars' loss when the crop is harvested. Other sources of contamination are also given, viz: The thrasher having previously been used for smutted wheat; being stored in a bin or passed through a fanning-mill or seeder not properly cleansed after being used for smutted wheat; by using sacks that have not been disinfected.

The third question is answered in the affirmative. It has been shown that corn smut can pass through animals and retain its germinating power, and the same is likely true of wheat smut.

Spores retain their power of germination when dry for two or three or even more years, but in the field we may safely assume that two years will eliminate every trace of it.

Natural checks to its increase are ably discussed; they are, mainly, probability that the spores may not be near enough to the germ end of the kernel, insufficient moisture, and resistant varieties.

The nature of the injury is of a more comprehensive nature than is generally supposed. A definite percentage of the crop is actually lost. An extra amount of cleaning and screening is required for what is good. The wheat is unfit for seed until disinfected. The smut gives the flour a dark color and disagreeable smell. The straw and screenings are liable to spread the disease when converted into manure.

Under the heading "remedies and precautions" the author says that the prevention of smut costs not a fraction of the trouble or expense that is necessary in removing the Colorado beetle from potato-vines. The method of disinfection preferred is a soaking of the seed in a solution of blue vitriol, and several methods for doing it are given in full. The methods of prevention are very emphatically summed up as follows: "Clean seed upon a clean field will result in a clean crop."

Very little space is given to the black smut; its general appearance, habits, and botanical characters are described. The same method of treatment as that described for stinking smut is recommended for this

except that, on account of the hulls, oats and barley should be soaked longer.—E. A. SOUTHWORTH.

BOLLEY, HENRY L. *The Heterœcismal Pucciniæ.* American Monthly Microscopical Journal, Vol. X, 1889.

The author of this paper starts with a general account of the biology and classification of the *Uredineæ*, gives a short description of the internal arrangement of the order, as well as its position among the fungi, and a definition of *heterœcism*, ascribing as a cause "inherent wants of the parasite not to be satisfied by one of its hosts alone," rather than to any difficulty which the promycelia might find to an entrance into the host tissue. Taking up the mycelium, a short description is given, with a belief that there are no true haustoria, but that young mycelial threads, penetrating the cell walls, give the misleading appearance. The article treats of æcidia and spermogonia at some length, without, however, attempting to clear up the mystery of their designed use. Under the account of the teleutospore, a doubt is expressed in regard to the existence of the so-called germ-pores. The author finds in the process of germination, instead of the passage of a germ-tube through a previously formed canal, a gradual erosion of the endospore from within. In regard to the question of sexual or non-sexual reproduction in the order, the work of Dr. George Massee is criticised, claim being made that the stroma, which bears ultimately the æcidial spores, does not consist, as figured by the latter, of a stalked body, but of a mass of interlaced hyphæ—branches and extensions of ordinary hyphæ. In the cases studied by Mr. Bolley *Æ. berberidis* and *Æ. hepaticarum*, the basidia arise as bud-like branches from individual hyphæ without any characteristics of a sexual process, and the author coincides with H. Marshall Ward in the thought that this process has disappeared, not being longer needed by the fungus.—D. G. FAIRCHILD.

FARLOW, W. G. *Notes on Fungi.* Botanical Gazette, August, 1889.

In the last number of the *Botanical Gazette* Dr. Farlow gives an account of a *Cystopus* causing peculiar swellings on the stems of *Ipomœa pandurata*, sent him by Prof. L. H. Pammel from Missouri. It appears from the note that the form of *Cystopus* upon the *Convolvulaceæ* of the United States has hitherto been found wanting in oospores, raising the question whether or not it should be united under *C. cubicus* (Strauss), Lév., which inhabits the *Compositæ*. The specimens sent by Professor Pammel seem to have abounded in peculiar oospores. The oogonia also differed from those of others of the same genus, in having their walls raised in blunt papillæ or short flexuous ridges over the whole surface. Differing as it does in oogonia and oospores from *C. cubicus*, the author thinks it clearly can not be placed under it. The name *C. convolvulaceæarum*, Otth, used by Kellerman and Ellis, is considered, after correspondence with Dr. Fischer, of Berne, as only a manuscript name used by